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ESSAYS AND CASES.

Art. I.—*Observations on the reciprocal Morbid Influences of the Abdominal and Thoracic Viscera.*—By the Editor.

Most diseases are seated in one or more of the great cavities—cranial thoracic, abdominal and pelvic. It rarely happens that any malady extends to the whole; but examples of the propagation of a morbid state from the organs of one cavity to the organs of another, are far from uncommon. I propose briefly to inquire into the modes in which diseases of the abdominal or portal viscera may raise diseases in the thoracic and *vice versa*.

I. Of the various ways in which the portal viscera may affect, unfavorably, the thoracic.

1. By Sympathy. I restrict the term sympathy to the influence which one organ exercises over another, through the instrumentality of the nervous system. How that system establishes associate and sympathetic actions, between organs remote from each other, we can no more explain, than we can tell why the same system makes us acquainted with the existence and properties of surrounding bodies. As without its aid, in the latter mode, we should be ignorant of what passes about us; so without its aid, in the former case, our organs would, in a great degree, be unacquainted with each others condition. They would not be combined into a physiological unit; but remain insulated, except as far as they

depended for the necessary nutriment on a common fountain. They would be like ununited provinces, scattered along the banks of a common river, from which they might all obtain supplies, and grow and flourish, according to the volume of its waters, while they were utterly unconscious of each others existence. Now it is the nature of the nervous function, to make the well-being of one organ, in some degree, a cause of the well-being of other organs; and the ill-being of one organ, a cause of the ill-being of other organs—sometimes one, sometimes more.

The question here arises, whether the organ diseased being given, we can determine *a priori*, what organ or organs will suffer through sympathy? I answer that, in general, we cannot. We might suppose that the viscus, most intimately associated with the affected organ, would be the first and greatest sufferer; but we do not find such, invariably, to be the fact; and many reasons might be assigned, why, if that assumption be theoretically, true, it may be often practically false. Thus, in the first place, there are other modes of propagation of disease, besides the one we are now considering, which may often modify or countervail it; and secondly, if an organ, congenitally or casually, happen to be in a bad condition, when disease is awakened in some other organ, the former may become the sympathizing sufferer, however remotely situated, or slightly connected, in its functions, with the latter.

But to return to the object in view, we repeat that disorder in the functions, of one or more of the abdominal viscera frequently carries disorder into the functions of the thoracic viscera, through the medium of the nervous tissue. The sub and super diaphragmatic organs are supplied by nerves, which have the most intimate anatomical relations. The pulmonary and cardiac plexuses are both formed by detachments from the pneumogastric nerves, united with others from the intercostal ganglions; and the splanchnic, have a similar composition, with an augmented proportion of ganglionic branches. Hence the nerves of the heart and lungs originate contiguous to those of the liver and stomach, and

are, of course, liable to be morbidly affected by the morbid states of the latter.

2. Excess of digestive function may contribute to the production of thoracic disease, by generating a plethoric state of the circulatory system: Thus palpitations and hypertrophies or hœmoptysis may sometimes depend, in part, though remotely, on excessive functional excitement in the digestive organs.

3. When inflammation, in one of the abdominal viscera, extends its influence to the heart and brain, and induces, in their functions, the change which leads to symptomatic fever, the heart is disordered by sympathy. In this state of increased energy and action, it may raise an inflammation in some of the thoracic tissues, which would, thus, become diseased through its intervention, presenting us with a different mode of propagation from either of those already mentioned.

4. The veins of the stomach may absorb foreign matters, which being carried directly to the heart and lungs, may act as irritants, and induce, or predispose to disease.

5. The digestive function of the stomach, bowels, liver and mesenteric glands, being disordered, chyle of an unhealthy quality must necessarily be prepared, which, being transmitted to the thoracic viscera, cannot fail to pervert their vital properties, and contribute to the production of a morbid state.

6. When the liver fails in the secretion of bile, and its elements are left in the blood, they prove injurious to the health of the heart and lungs, in common with the other organs of the body. As the bile performs an important office in the bowels, we cannot refer it to the class of purely excrementitious fluids, like the urine and perspiration; but still there are numerous facts which demonstrate, that its elements are developed in the blood, and must be eliminated from it. As it respects the blood vessels, they are excrementitious; and to the lungs they seem especially prejudicial. They probably irritate that organ into a kind of vicarious excretory action. Between the liver and lungs, there is this analogy that they are both transmitting organs of venous blood;—

one for the abdominal viscera, the other for the whole body; and at the same time, they exert upon it a species of depuratory action. An interrupted excretion of bile from the ducts of the liver, is known to be followed by the return of that fluid to the blood, where it plays nearly the same mischievous part with the retained elements. It is worthy of remark, that the influence of the biliary elements is exerted largely upon the serous membranes, producing dropsical effusions, and hence, in part, the frequency of hydrothorax and hydropericardium in hepatic disorders.

7. Enlargement of the liver prevents the full and easy descent of the diaphragm, and thus embarrasses the lungs in their operations.

8, And lastly. The muscles of respiration are subservient to several offices of the abdominal viscera; such, for example, as vomiting and fæcal evacuation; and, therefore, it is necessary to give to these organs the power of exciting those muscles. This is effected through the medium of the nervous system, and is, indeed, a species of sympathy. In certain kinds of abdominal irritation, the muscles of respiration are thrown into spasmodic action; as we see in a paroxysm of asthma from acid or bile in the stomach.

It seldom happens, indeed never, that the morbid influence of the abdominal over the thoracic functions is exercised in any single mode here pointed out. They are of necessity combined. Thus, in dyspepsia, the lungs and heart are affected through the nervous system, that is sympathetically, and at the same time, such unhealthy chyle may be sent to those organs as must contribute to the production of their derivative maladies. And, thus, when the liver is inflamed, the lungs and the respiratory muscles may be injured through the nervous tissue, while, simultaneously, the secretions of bile being, partly or wholly, suspended, the lungs or their membranes may suffer greatly from that cause, in the manner pointed out.

As to the relative influence of the different modes which I have assigned, it would be difficult—or rather impossible—to speak with precision. The principal seem to me to be the

three following, which are influential in the order of enumeration.—1. Nervous connexion. 2. Suspended or perverted hepatic secretion. 3. Morbid chylification.

II. Of the morbid influence of the thoracic viscera, upon the abdominal.

The organs of the chest, when diseased, may carry a morbid action into those of the abdomen; but the modes in which they effect this, are fewer than those in which the latter influence the former.

1. When the heart or lungs is diseased, the digestive organs are liable to suffer from sympathy; of which we have examples in the anorexia and constipation, generally, attendant on acute pneumonic inflammation; in the vomiting which accompanies pericarditis; and, perhaps, in the diarrhœa and fistula in ano, which occur in Phthisis.

2. When, from any cause, the heart is greatly excited, it may raise an inflammation in the abdominal viscera as well as in any other part of the system.

3. When the lungs are so diseased as to perform their function of æreation imperfectly, it is probable, that the matters which they should eliminate, are sometimes thrown upon the liver, or the gastro-enteritic mucus membrane, contributing to the production of diarrhœa.

4, and lastly. When the lungs fail in their transmitting power, or the right side of the heart, which maintains the pulmonary circulation, has suffered such a lesion that it cannot act efficiently, the returning blood is obstructed and accumulated in the venæ cavæ, and the circulation in the liver is of course disturbed. Hence, in part, the hepatic disorders so often present in organic affections of the chest; and so frequently mistaken for the cause of that of which, in reality, they are the effect.

From this synoptic view of the reciprocal morbid influences of the abdominal and thoracic viscera, we might infer that the former preponderate over the latter; in other words, that the heart and lungs are oftener thrown into disorder, by diseases of the liver, stomach and bowels, than the latter are by the maladies of the former; and such we know to be the

fact. Thus, observation confirms the suggestions of theory; and demonstrates the utility of a reference to the anatomical and physiological relations of the organs, when we would understand the propagation of morbid actions through the system.

As the object of this little paper was chiefly to indicate the principal modes of morbid intercourse between the organs of two great cavities, I might here bring it to a close; but not having trespassed long upon the patience of the reader, I shall devote a few pages to the morbid influences of the principal viscera of each of those cavities, upon one another.

III. Of the abdominal organs. These are intimately united, both in structure and function. The peritoneum envelopes the whole—their veins unite to form the vena portæ—and their nerves are derived from the great solar plexus. Each organ is destined to perform an office, which is an element in the aggregated function of digestion, and should it fail, the whole abdominal economy is liable to disturbance. Of the modes in which this disturbance may occur, the following are the principal:

1. These organs influence each by sympathy. Thus, acidity of the stomach impairs the peristaltic action of the bowels and *vice versa*. Diseases of the liver produce an irritable stomach, and even excite vomiting. Peritonitis occasions obstinate costiveness. The sympathies of these viscera are, in short, both intense and numerous, as might be inferred from the intimacy of their nervous connexions.

2. When the liver fails in transmitting the blood of the vena portæ, the circulation and specific functions of all the other portal viscera, are necessarily disordered. Among other maladies consequent upon this abdominal plethora, is ascites from increased serous exhalation.

3. When that organ fails to secrete or to excrete bile, the bowels can neither form healthy chyle, nor properly discharge their fœcal contents.

4. When the liver is perverted in its action, or greatly excited, it pours out a biliary fluid, vitiated in quality or re-

dundant in quantity, the stomach and bowels are irritated, and vomiting and diarrhœa, or both, may be the consequence.

5. When the pancreas is enlarged, it sometimes occasions jaundice, by pressure on the common gall duct.

6. When the rectum is contracted, it produces intestinal torpor and remora.

A remark already made, in reference to the reciprocal influence of the thoracic and abdominal organs, is applicable to the morbid influences which the latter exert on each other—it is, perhaps, never in a single mode only. Thus, at the same time, that the diseased liver affects the stomach and bowels, by sympathy—that is, through the medium of the nervous system, producing an altered state of their sensibilities,—it pours into them excessive quantities of acrid bile, which, by its irritation, converts perverted excitability into perverted excitement.

IV. Reciprocal morbid influences of the lungs and heart.

a. The lungs, when diseased, disturb the actions of the heart—

1. By sympathy. These great organs are not more remarkable for juxta position, than harmony of action—a relation which could only be established and maintained by the agency of the nervous system. Hence the nerves of both organs are derived from a common plexus, and if either is disturbed in its sensibilities, the other, of necessity, sympathizes. An augmented action of the heart is, therefore, an invariable effect of inordinate pulmonary excitement.

But it is not through the instrumentality of their vital properties only, that diseases of the lungs occasion diseases of the heart. They operate in other modes which are more mechanical, and therefore, more obvious.

2. When, from any cause, the lungs fail properly to æreate the blood, the cavities of the left heart are filled with blood of a bad quality, which must, necessarily, disturb its healthy actions; but the greatest perverted influence is, perhaps, to be found in the admission of this kind of blood into the substance of the heart, through the coronary arteries.

3. When the transmitting power of the lungs is impaired, the blood is necessarily accumulated in the right side of the heart and in the coronary veins, thus producing distension of its cavities and plethora of the vessels of its substance, with great consequent embarrassment of action.

4. In this state of coronary or cardiac plethora, increased serous exhalation may take place, from the internal surface of the pericardium, producing hydropsericardii.

b. Diseases of the heart may excite diseases of the lungs in several ways.

1. By sympathy, on which I shall make no remarks.

2. By hypertrophy of the left ventricle diminishing its cavity, or ossification of the mitral or semilunar valves, interrupting the free admission of blood into and out of that cavity; all of which must, necessarily, embarrass the lungs, by impeding the transmission of blood through them.

3. By passive aneurism of the right ventricle of the heart, which being thus weakened, cannot send the blood into the pulmonary artery with sufficient force to secure its proper transmission through the lungs.

4. By active aneurism of the same ventricle, which gives it excess of power over the lungs, and may lead to pulmonary apoplexy, and other forms of sanguineous engorgement.

5. By enlargement of all the cavities of the heart, causing that organ to occupy more than its proper space, and, consequently, preventing the free expansion of the lungs, thus producing dyspnœa.

As in the case of the other organs, the heart seldom, perhaps, exerts itself, unfavourably, on the lungs, in one of these modes only. They are generally combined, though one member of the combination may far exceed the rest in efficiency.

I shall close with a few brief remarks. The human body is a piece of most complicated mechanism, and the assumption, that morbid actions are propagated through it, by any single principle, such as sympathy, or a *vis medicatrix*, must, forever, as it has done heretofore, prove fatal to the system of pathology into which it may be introduced. In every

complex machine, if one of the component parts should fail in its office, some other will, of necessity, experience injury, and being crippled in its movements, may, ever, disturb the motion of several, until the irritation, by a kind of geometrical progression, is communicated to the whole. But in the living body, long before this takes place, from dependence of function, the parts most remote from that first injured, may be affected, and the whole system involved, in two other modes, examples of which I have already given; but may here refer to them again. Two tissues, each continuous with itself, pervade every part of the body—they are the nervous and the vascular. Of the nature of the agent which resides in the former, we know nothing; but observation teaches us that an impression made on a part, even the most circumscribed, provided the nerves leading to it are perfect, can be felt, in its effects throughout the whole system, even to the annihilation of its vital properties; and, that this phenomena is referable to the nervous system, is apparent, from the fact, that plants which are without a nervous system, at least any distinct tissue of that kind, cannot be *generally* affected by topical applications, and hence their diseases are mostly local and circumscribed.

The other universal tissue has an unquestionable agency in the production of general disease, although by many fashionable writers of the day, its influence is overlooked. Whoever has attentively examined the blood of a patient labouring under an inflammation, must have seen, even while the orifice was still bleeding, that it is by no means in a healthy state. A slate colored surface often begins to appear, at the very moment of its reception in the bowl, indicating, conclusively, that a decomposition into its proximate elements, had begun while it was still in the vessels and circulating through the organs. This, however, is but one of the changes, which it may have undergone, and inflammation is but one form of morbid action. We are, in fact, very far from knowing to what extent and in what manner, the blood may be vitiated in its qualities by the multitude of original morbid states, which may be established in the different organs;—for the colour of

the fluid, and the peculiar chemistry which combines its numerous elements, render all researches into its condition exceedingly difficult, and quite uncertain in their results.—Nevertheless, we may be assured of the truth of these two assertions; first, that every local disease must change the qualities of the blood, which is made to circulate through the diseased part: Secondly, that this fluid carried into the other organs, must, necessarily, disturb their vital properties; and hence, that the circulating blood may be the means of awakening diseased organs in parts of the system very distant from that first affected.

(To be continued.)

ART. II.—*Some observations on Ulceration of the Kidneys, with cases*—By JOHN C. WARREN, M. D.

From the Boston Medical and Surgical Journal, No. 30.

The disease of ulceration of the kidneys is of not unfrequent occurrence. There is an obscurity in the symptoms of this distressing complaint, which causes it to be mistaken for diseases of the bladder, or of the urethra: and to the great distress and even destruction of the patient, the treatment is directed to the urethra or bladder instead of the real seat of the disease.

It is not in my power to dissipate the obscurity which involves the symptoms of this affection. But I have met with some cases in which the phenomena were observed with considerable care; and their causes afterwards verified by examination of the dead body. The publication of these will serve to call the attention of others to the subject; and lead to the discrimination of this obstinate complaint.

I will first state the case, and then add such remarks as they may suggest.

The first of these cases I visited in consultation with my friend, Dr. J. P. Spooner, to whom I am indebted for the history of the disease and dissection.

CASE 1. Mr. ————, æt. 29, in Feb., 1823, complained of passing bloody urine. This occurred in greater or less quantity every day—generally more in the evening than in the morning. Sometimes the urine was slightly tinged; at other times a few drops of blood followed the evacuation; at others again the whole quantity was deeply tinged, so that it had to him the appearance of pure blood. It was increased after drinking of vinous and spirituous liquors,—after indulgence at the table,—after long sitting, as he was in the

habit of doing with his feet raised above the level of the chair,—after bodily or mental fatigue. Occasionally after long sitting, or after having passed a large quantity of urine, he felt a pain in the region of the kidneys. With the exception of some symptoms of dyspepsia, the bloody urine and an occasional pain in the small of his back, were all of his complaints. He was directed a cathartic of pil. aloes, and colocynth and calomel,—a spare diet,—the constant use of a decoction of uva ursi,—and tincture of sulphuric acid. For a short time his symptoms seemed to abate. As the spring opened, he took a journey to the south, which was of benefit to his general health, but was of no service to his particular difficulty. Through the summer he complained but little, but in the autumn he became worse. The urine was more uniformly bloody, he often passed large clots of blood, and began to appear emaciated.

The sulphate of copper and the acetate of lead were successively resorted to, but as they both disagreed with the stomach and bowels, their use was discontinued. In December two issues were made, one over each kidney. The effect of these issues was a sudden diminution in the quantity of urine and also in the quantity of blood; but a new symptom now appeared, viz., a pain following the discharge of urine. An apparent improvement in his condition continued for several months, with the exception of the pain just alluded to, which became more and more troublesome.

March 15th, 1824. My notes say he has had no discharge of blood for a fortnight, excepting a slight tinge this afternoon. Within the last week he has had a pain attack him in the right knee, which passed to the calf and thence to the knee of the other leg. His bowels are still liable to derangement from slight causes. The issues continue to discharge, although they are smaller than they have been. April 1st. As the painful affection left the knee the discharge of blood returned. The pain of passing urine is now extreme, and is often accompanied with tenesmus to such a degree that it sometimes produces involuntary discharge of thefæces; followed by shortness of breath. Bowels very irregular; countenance pale and emaciated. By the advice of some of his physicians he sailed to day for Richmond.

June 1st. Returned worse; dysuria increased; very much emaciated; constant dry cough; difficulty in respiration. Gave him squill pills, applied leeches over the publis, and on going to bed gave him an injection of flaxseed tea and laudanum.

This treatment afforded entire relief to his pulmonary complaints, and very much mitigated his other sufferings. The injection was continued nightly for a long time with much benefit. But as the summer advanced, his complaints became worse. Frequent vomitings, with severe paroxysms of pain, seized him, his legs became œdematous, and he was constantly troubled with a dribbling of urine, for which he was obliged to wear oiled silk bags made for the purpose. In September he made a short visit to Nahant. After his return, his

situation was truly distressing. He would be seized several times in the course of an hour with excruciating pains, which seemed almost insupportable; his legs were painfully distended; and he rejected with distressing retching almost every thing he took. Nothing could be done for his relief. The injections of laudanum and flax-seed had lost most of their good effects, and there was this objection to them that they seemed to increase the irritibility of the stomach. At this time, whilst I was assisting him into bed, he was seized with one of his paroxysms. I immediately pressed upon the small of the back with all my strength, at the same time passing my hands up and down. This gave him instantaneous and entire relief. I continued with him through the night, and resorted to the same method whenever he had warning of an approaching paroxysm, and uniformly with relief.

From the time of his returning, (20th of Sept.) from Nahant, he was no longer able to attend to his business.

By rest from the active duties of life, and by resorting to the method just stated, his distress was much mitigated; but he gradually declined until he died, on the 17th October, 1824, being twenty months from the time of his first complaining.

After death an examination was made by Drs. Ware, Doane, and Wells. The right kidney was found very much enlarged, being twice the common size, and of an unusually light color; its consistence not much altered. The left kidney not much altered. The ureters were much distended. The bladder was very much diseased, being in a scirrhous state, in some parts an inch or more thick; its cavity of course much diminished. The state of the bladder accounted for the distressing paroxysms of pain which he suffered, and which resembled the severe pains of a woman in labor, more than any thing to which I could compare them. And the appearance of the bladder reminded me of what we may suppose that of the uterus to be soon after parturition. The mucous membrane of the stomach and intestines was also much inflamed. The distention of the ureters can be accounted for from the state of the bladder, which presented a mechanical obstruction to the passage of the urine. Whether the primary disease occurred in the bladder or kidneys, it seems impossible to determine. But from the order of the symptoms I have been inclined to refer it to the kidneys.

Case 2. This case I saw in consultation with Dr. William J. Walker, of Charlestown, who has had the goodness to favor me with a history of the case and to send me the diseased kidney. He has added two other cases of remarkable disease in this same organ.

Mr. L. Lincoln, a married man of excellent character, correct habits, forty years of age, by trade a sailmaker, and who had never been affected with any venereal complaints, applied to me, three years since, on account of a serious disease of the urinary organs. He informed me that this disease commenced about eight years before that

time, and could not be ascribed to any palpable cause. At first he had frequent calls to pass urine, attended with a heat and itching about the orifice of the urethra and glans penis. This difficulty at first appeared to yield to the use of nitrous ether and laudanum, combined with mucilages. This relief was, however, only momentary, for the complaint returned in paroxysms, and gradually became more severe, until it destroyed the comfort, health, and finally the life of its victim. At the commencement of my attendance I noted the following symptoms. He was somewhat wasted in flesh; his countenance was anxious; his pulse and skin natural, except when suffering from a parozysm of pain. At this time he would sweat freely, yet his pulse would be but little altered from its healthy state. He was unable to retain his urine more than one or two hours, and never voided more than four to six ounces at a time. The urine was always clear, never deposited a sediment, never contained either blood, mucus or pus, and always appeared of a healthy straw color. He now had a constant pain at the end of the yard, and a sense of weight about the rectum, which frequently induced him to go to stool without effect. This symptom was not dependent upon piles, for on examination per anum, I detected no disease of the anus, rectum, or prostrate gland. His urine frequently stopped suddenly during its excretion. His paroxysms were preceded and attended by a diminished flow of urine, and his relief always attended by a more copious flow of this fluid. A sound introduced into the bladder came in contact with no stone. Yet when its point was directed to a certain part of the bladder, it produced a sensation of touching some substance harder than the coats of the bladder, but without the shock which is felt when the sound comes in contact with a stone. The introduction of the sound gave more pain than is usual with others, but its use, and even its free use, was not followed by protracted pain, bleeding, or any sensible change in the urine. From the difficulty of the dianosis, I was induced to use the sound and to vary its form more freely than I should have done had I known the state of the bladder as found on dissection. During his paroxysms of suffering he constantly complained of the most acute pain in the right inguinal region. This spot he said he could cover with the point of his finger. His gait was peculiar. He walked with his legs wide apart, swinging forward as it were first one side of the body and then the other, without flexing the limbs, so as not to jar the system. While walking, he usually had the right hand in his trowsers, holding the penis. His body was constantly inclined to the right side, and although in the prime of life he had the stoop forward, and every way the motions, of a man in the decrepitude of age. As the constitution of my patient was naturally good, his digestive organs in perfect state, except when interrupted by the most agonising pain; as he had no febrile symptoms, and as all his sufferings had reference to the urinary apparatus only, he received no treatment, save only such as might probably obviate or mitigate the sufferings which he endured.

At the time of his greatest suffering he was three times bled by leeches. They were applied in considerable numbers to the perineum and the skin over the external abdominal ring. After each application he complained of more pain than ordinary, and said the bleeding hurt him. Of the truth of his suffering more for the leeching I am by no means certain; I am however, that it did him no good. Saline cathartics were of no service, if we except soda and Rochelle powders, when they did not prove too operative. Pyrola umbellata, uva ursi, gum Arabic decoctions of mucilaginous seeds, and mucilaginous drinks, generally gave some, yet but little relief. Nitrous ether, nitrous ether and oil of juniper, and bals. copavia, appeared sometimes of service, and sometimes worse than useless. Tonic medicines were aiways prejudicial. Fomentations, enemas, and all topical applications, failed of giving relief. Opium, belladonna, and conicum maculatum, did no other good than to relieve pain for the time. As to diet, stimulating food did harm. Tender succulent vagetables, farinaceous articles and ripe fruits, proved most friendly. He expressed great relief from the use of asparagus, berries, milk, &c. Whenever his suffering intermitted for a time, he would get a good appetite and increase in flesh; but a return of pain would soon reduce him to his former state.

Finally, worn down by pain, and despondent, he yielded himself to quackery, swallowed the infallible potions, and gave full credit to the last medicine used during a paroxysm, until a new period of pain convinced him of his mistake. A colliquative diarrhœa came on, which no medicine could restrain, and he died.

On opening the body I found no part diseased except the urinary organs. By removing the superjacent parts, the kidney appeared about four or five times its natural size; and the ureter, through its whole course as large as a man's thumb, was indurated, thickened, and apparently shortened. It was as it were stretched from one viscus to another, and might account for the constant inclination of the body to the right side. On removing the kidney and ureter from their natural situation, I found their cavities not materially enlarged. The increase of size arose from an increased thickness of the parenchymatious substance of the kidney and the coats of the ureter. The cavities of the kidney and ureter, were in a state of supporation. At this I was not a little surprised, as I have before stated that I had never detected in the urine either blood, pus or mucus. I at first thought that the ureter might be impervious, but by using the blowpipe, air passed readily into the bladder and to the kidneys. Here then we had an extensive suppurating cavity communicating with the bladder, and yet until within a few days of the patient's death no matter could be found in the urine. I say until within a few days of his death; for after my examination I learned of his wife that for the three or four last days of his life his urine looked as if a little milk had been mixed with it. Before that time I can answer that it did not exist, as I was in the habit of inspecting it frequently, and had

enjoined it upon my patient to save for my own eye any thing deviating from a perfectly natural appearance in this excretion. Here sir let me ask, when did this suppuration commence! Within a few days of the patient's death? or at a much earlier period? Is it possible that so extensive a suppuration could have existed in these parts, and no matter be detected in the urine? and yet can it be possible that suppuration had not longer existed? considering the extent of disease, and the almost unequivocal marks of protracted ulceration and suppuration exhibited by the preparation now in your possession. On turning my attention to the bladder itself, I found its coats remarkably thin and weak, so much so that in endeavoring to separate it from the circumjacent cellular membrane, my fingers passed through into its cavity. In other cases of contraction of the size of the bladder, I believe the coats of this organ are thickened and strong; at least it has been so with all those cases which have come to my knowledge. The mucus membrane was changed from its natural appearance to a smooth substance, covered by minute granular shining points, which felt to the finger almost as hard as cartilage. The indulated part struck by the sound proved to be the end of the ureter where it enters the bladder. The sensation communicated to the fingers by touching this part of the bladder with the sound, the fact that the pain was principally in that place, and the difficulty of the diagnosis, led me to the belief that there might be a stone either impacted in the ureter or encysted in this part of the bladder. On viewing the smallness of the bladder and the tenuity of its coats, and reflecting on the freedom with which I had used the sound in this case, I could but be surprised that the point of this instrument had not done irreparable mischief.

Case 3. In the year 1815 I was requested by my preceptor and friend, (the late Governor Brooks) to examine a child of Mr. Calvin Turner, who had died of an immense tumor in the abdomen. The whole body, previous to any dissection, weighed twenty-seven pounds. Having laid open the abdomen, I found the tumor was one of the kidneys, which, when removed from its connexions, weighed fourteen pounds, being one pound more than the residue of the body. On opening this kidney, I found its upper extremity had degenerated into a firm white substance, almost cartilaginous, but becoming less white and less hard as it approached the middle part, where it had the color and natural appearance of the parenchymatous substance of the kidney in a natural state. The whole structure of this tumor resembled very nearly a natural kidney, allowance being made for its immense size. From its tubuli I pressed out urine having all the sensible properties of that fluid. Urine was also found in the pelvis of the kidney, and in the ureter. What the symptoms were which attended this case I cannot say, as I never saw the patient until I was called upon to make the dissection. I learned from Governor Brooks, however, that this was the third case of a similar disease which had

occurred in his extensive practice, and that so little did the symptoms point to the precise nature of the disease, that in one case the spleen was supposed the part diseased, and in the other no satisfactory diagnosis could be formed till after dissection.

Case 4. About eleven years since I was requested to visit a Mr. Bailey, living in Tewksbury. The messenger who called on me, (himself a medical man,) wished me to go prepared to perform an operation upon a large tumor situated upon the patient's left side, and which was supposed to be a suppuration of the spleen. On arriving at my patient's house, I found a number of medical men who had convened to consult on the case, and to give assistance in any operation which might be deemed expedient. We found, by examining the side, a large tumor, which had the appearance of pointing in two different places. The one was near the margin of the false ribs, about four inches from the ensiform cartilage, and the other about four inches from the first in a line toward the posterior spinous process of the ileum. The skin over these points appeared reddish, and the parts thinner than at any other places. No one doubted that he felt fluctuation at these points, and even that fluctuation could be felt in the one by tapping on the other. The operation had been proposed to the patient by highly respectable gentlemen who had visited him previous to myself. All present thought it necessary. The patient and his wife ardently wished it done, expecting that a discharge of matter would give great relief. As the operation devolved upon me, and as I was at that time young in the profession, I went alone into my patient's room, that I might examine the case a little more carefully. This second thought proved fortunate for me, for by engaging the man in conversation, by altering his position in bed, by having his legs raised, while I made my investigations, and by similar manœuvres, I convinced myself that what appeared to be fluctuation might be only the slipping of a tumor under the parietes of the abdomen. Suspicion being roused, I pursued my inquiries until I was fully convinced that the safety of the surgeon as well as of the patient required forbearance. Perhaps the countenance of my patient, and his extreme emaciation, assisted me in the diagnosis. The countenance was that of a man laboring under incurable visceral disease; an appearance which I will not undertake to describe, but which the attentive observing practitioner will readily know, after having once seen it. I had now got myself into trouble, for the patient and his wife insisted on having the operation done, saying he could only die, and that this operation constituted his only hope. In addition to this, some of my medical friends could not give up their preconceived opinion. They quoted my words just given, that there was fluctuation in the tumor. Finally, with much difficulty, I persuaded my patient and friends that it might be better to wait two or three weeks and to have the opening made at that time, if he should still wish it, and if it should then appear feasible. Under

these circumstances I left my patient, satisfied I had established a reputation for timidity, and equally satisfied that I had found in my composition so much of that better part of valor called discretion.

In a sdort time this man died. His body was examined by my much esteemed friend, Dr. Rufus Wyman. The tumor proved to be the kidney; was greatly enlarged; had formed no adhesions with the peritoneum opposite where it had pointed; was so soft in its texture that those present thought it contained a fluid until it was removed from the body and opened. This opening proved it to be of a soft spongy nature, and was thought by Dr. Wyman to be of the nature of fungus hæmatodes. This however was not all, for the colon, in a distended state, passed directly over the two projecting points, in such a manner as to have been infallibly opened by any incision into the tumor.

As this case had been attended by highly respectable practitioners, and as the urinary secretions and excretions had been so well performed as not to point out the parts diseased, may we not consider the following corollaries as established, viz., that great and even fatal disease may exist in the urinary apparatus, and yet not be discoverable by any known symptoms, and that a disease or irritation existing in one part of said apparatus, may produce symptoms of disease in any other part of the same.

Case 5. Charles E. Fessenden applied to me in the autumn of 1827. He had an inclination to pass water very frequently, with blood occasionally and a small quantity of mucous. The stream was rather small. I passed a bougie, and found an obstruction in the further part of the urethra. On two more applications this disappeared. He was not, however, relieved; nor did the medicines I afterwards gave, produce any mitigation of his symptoms. Satisfied that I should never be able to discover the nature of his complaint by the observations I could make in his occasional visits to me, I advised the young gentleman to go to the Hospital. The history of his case was there recorded as follows. Although long, I have not thought it best to omit any part of the history of the symptoms or treatment; as useful results may perhaps be drawn from them,—if not now, at some future time.

C. E. Fessenden, æt. 19, Boston. Entered the Hospital Dec. 3d, 1827. Constitution naturally good, but subject to frequent headache, and indigestion. Four months ago, received a severe strain in his back, from lifting a heavy weight. A fortnight after this, he began to feel a severe pain across the small of the back. After about a fortnight, this subsided, and was succeeded by a burning pain, about an inch from the extremity of the penis, coming on after micturition. Urine became darker colored than usual, depositing a mucous sediment. For the last three months has occasionally passed blood with his urine. Urine passed occasionally eighty times in the twenty-four hours, preventing his sleeping by the frequent necessity of rising.

The pain in the back recurred about a fortnight before he entered the Hospital. Subject to costiveness.

Dec. 4. Warm bath every other day.

℞ Potass. sup. carb. ʒij.
Aquæ, ʒvj.
Syrup. tolutan. ʒ iss.
Ol. junip. ʒ ss. M.
Cap. ʒ ss. ter in die.

May have meat; but no butter or fat.

6th. Sound passed, but no stone discovered in the bladder. Passed about a gill of blood.

℞ Sol. sulph magnes. ʒ iv.
Appl. hirud. vj. perineo, altern. diebus.

9th. Sound again passed, but no stone discovered.

Omitt. medicamenta.
Sum. pulv. uv. ursi, ℈ ij. ter in die.
Cap. pil. hyd. submur. et opii. nocte.

10th. Costive.

Sum. sol. mag. sulph. ʒ iv.

12th. Less pain after passing urine, and less frequent calls.—Pains across loins much diminished since entrance. Has passed but a few ounces of blood since the 5th.

Sum. sol. mag. sulph. ʒ ij. altern. diebus, mane.

17th. Improved every way. Warm bath only twice a week.

27th. General improvement. Mouth slightly affected. Less tickling about penis since entrance. Has a new sensation of burning just within the urethra and in the bladder before passing urine, relieved after evacuation. Passes urine four or five times daily; quantity as usual. Mucous sediment continues, but no blood for a considerable time.

Omitt. sol. mag. sulph.

Jan. 1. Doing well. Burning in penis and bladder, before passing urine, continues. No pain in any part. No blood.

Appl. hirud. bis in hebdomada.

14th. Mouth continues slightly sore.

18th.

Sum. pil. submur. et opii. bis in die.

25th. Calls to pass urine of late more frequent. For several days severe but momentary pain, in end of penis after passing water. Has to-day severe pain across small of back, chiefly before and after passing urine.

Omitt. uv. ursi et. pil.
Sum. balsam copaib. gtts. xxx. in aq. ter in die.
Csntinue bath.

28th. Has taken cold and looks less well. Pain in back, and pain after passing water continue. For several days has constantly passed blood with urine. Since balsam, quantity of urine diminished; more frequent calls. On the 26th, passed urine sixty times.

Mucous sediment increased. Also burning in penis and bladder before passing urine. Ardor urinæ lately; none now.

Appl. empl. canth. iij. ad vj. dig. dorso.

30th. Better; has not taken the balsam very regularly. May walk out.

Appl. part. vesicat. unguent. junip.
Omitt. balsamum.

Feb. 2. Sharp aching pain near the extremity of the penis, commencing yesterday about 1, P. M. and lasting till 8 or 9. Very little burning pain in penis, and very little pain in back since blister was applied. None since yesterday morning. Less disturbed in night by necessity of passing urine. Urine in larger quantities. Sleep better than usual. Bowels regular.

3d. Pain in back recurred yesterday afternoon after a dinner of salt fish, and lasted about seven hours. Had a very uncomfortable night. Passed urine about four times. Severe pain after passing it; slight burning pain before; Urine scalding.

4th. Yesterday and last night more comfortable. Slight aching pain in penis for about an hour. Pain in back as on the day before.

5th.

℞. Pulv. uv. ursi, ʒj. ter in die.

6th. Less pain in back; recurred about three times in the day, lasting about fifteen minutes at a time. Burning pain for about half an hour after micturition. Urine diminished in quantity. Passed about eight times in the day; four times in the night. Pain before micturition less severe. Urine scalding. Bowels free.

8th. No recurrence of pain in back. Burning pain in penis as usual. Pain in extremity of penis before micturition. No pain last night after micturition. Slept well. Urine as usual. Pain for about two hours this morning; relieved by drinking slippery elm tea. This morning much increased by motion; this has not been the case before. Bowels free.

11th. Has continued to gain since the 6th. No recurrence of pain in the back. Pains in penis slight. Appetite good. Health good. Has lost in weight during the last fortnight, but never before.

12th. Passes urine eight times a day; four times in the night. Passes no blood. Mucous sediment rather less.

℞. Tinct. mur. ferri et ammon. gtts. xv. ter in die.
Sum. inf. lini. semin. ʒ ij. quarta quaque hora.
℞. Tinct. capsic. ʒ iv.
Tinct. canth. ʒ j. M.
Utet. pro lotione dorso.
Cont. baln. tepid. et uva ursi.

13th. Continues to improve. Has not now the sensation of weariness which he formerly experienced at night. Strength increases. Has gained flesh.

14th. Continues to amend. Allowed, at request, to go out this evening.

16th. Feels much better than at any time since his entrance.—Urine passed about twenty times a day.

18th. Has been worse since the morning of the 16th. Pains increased. Urine passed more frequently, in smaller quantity, and with more sediment.

19th.

Omitt. omnia preter lotiones et balneum.

℞. sol. sulph. mag. ʒ iv.

20th. Much better this morning. Night very good. Twelve dejections from medicine, copious. Sharp burning pain yesterday after micturition, for about half an hour at a time. This is much increased, and is often brought on by motion. Severe itching pain this morning, lasting about half an hour at a time.

21st.

℞. Hyd. submur.
Pil. scillæ, aa gr. xij. M. Ft. pil. No. xij.
Cap. unam, mane et vespere. Cont cetera.

22d. Worse since yesterday's visit. Urine, according to report, somewhat tinged with blood; otherwise as before.

23d.

Omitt. pil. mane.

26th. Has been much worse since the 22d, to-day especially. Pains severe, recurring constantly upon exercise. Feeling of great weariness. Little appetite. Uneasiness, though not exactly pain, in the back. Pain in left groin, over a circular space of the size of a dollar, previous to passing urine. Bowels generally irregular when not under the influence of medicine. At present rather costive.

Omitt. hirud. applic.
Sum. pil. hyd. submur. mane et vespere.

27th. Last night and this morning much better. Takes daily a quart of the decoction of slippery elm.

28th. Much better.

March 1. Feverish.

℞. Spirit. æth. nitros. gtts. xl.
Quarta quaque hora. Cont. pil. hyd. submur.
℞. Acid. sulphur. ʒij.
Ol. olivæ, ʒij. M.
Appl. dorso pro linimento, mane et vespere.

3d. Pains have rather increased in consequence of his taking cold. Pain in the back for about half an hour yesterday. Passes urine about thirteen times in the night. Great weakness, especially at night.

4th. Urine passed twenty times in the night; in sufficient quantity, rather light colored, depositing some reddish flocculi. Vomited this morning after breakfast.

℞. Ant. tart. gr. x.

Aquæ ʒ iij. M.

Cap. ʒ ss. semi horis, pro emetico.

6th. Pains increased on account of his eating salt, by which his symptoms are always exacerbated.

℞. Pulv. uv. ursi, ℈ ij. ter in die.

Cont. cetera.

7th. Much better.

8th. Tongue furred, and other symptoms of fever.

℞. Hyd. submur.

Pulv. jalapæ, aa gr. viij. M.

Cap. statim.—Omitt. medicament. solita.—Liquid diet.

10th. Was quite weak and in bed nearly all day on the 8th and yesterday. After dinner yesterday, was seized with vomiting, and paroxysms of violent pain ensued. Appearance under the paroxysms, and symptoms, were as follows:

Countenance very much distressed and pale; writhing in bed; scalding in urethra, as from a hot iron passed into it; excruciating pain in the end of the penis, and in the left testicle, descending from the symphysis pubis; itching in the penis within the perineum; pulse smaller than usual, not much accelerated; feet very cold; on examination, slight retraction of testicle, but otherwise the appearance natural. Pains came on immediately after passing urine. This attack continued about two hours, when he became relieved. A second paroxysm, similar to the former, commenced at 6, P. M.

During the first paroxysm he was directed by the house physician to take slippery elm tea, and continue this as long as the pain lasted. Fomentation of hops applied about the pubes, and kept hot. While this is preparing, foment with hot water. Enema of tepid flaxseed tea, half a pint, and laudanum, seventy-five drops.

Second paroxysm, opiate enema, tr. camph. opiat. gtts. xl.; spirit. æth. nit. gtts. xxx. M. In the evening, hop fomentation, with a strong decoction of poppies. At 9, spirit. æth. nit. gtts. xlv.; repeated at half past 11. At 2. A. M. tinc. opii. gtts. xxv.

This attack left him very feeble, and he continued in bed for two or three days, but had no severe pain, and gradually mended.

15th. Return to usual diet.

Cont. pil. mane et vespere.

17th. Countenance continues pallid. Passes urine about fifteen times in the night, with some clots of blood. Sediment somewhat increased.

19th. Passed a very comfortable night. Bladder again sounded. Passing the catheter into the bladder produced exquisite pain. Felt in the bladder, as he said, like a red hot iron.

Cap. pil. unam vespere.

Appl. empl. canth. dig. iv. abdomini.

24th. Complains of an itching about the anus, which he says he has experienced from the commencement of the disease. Has lost fourteen pounds of flesh within a fortnight.

Diet,—for dinner, fish, oysters, broiled chicken; for breakfast, eggs, toasted bread, crackers, shells, cocoa or arrowroot.

Sum. pulv. uv. ursi, gr. xx. ter in die.

℞. Hyd. submur.
Camphoræ,
Opii. aa gr. vj. M. Ft. pil. No. vj.
Cujus, cap. unam vespere.

27th. Urine within the last twenty-four hours, eighty ounces.—Has gained strength.

Sum. uv. ursi, ʒj. ter in die.

28th. Severe pain in the lower part of the abdomen.

Appl. empl. canth. digit. iv. abdomini.

31st. Slight relief to abdominal pain from blister. Nights uneasy.

Sum. vespere, ext. hyoscyami, gr. vj.

April 4. No effect from hyoscyamus.

Omitt. pil. hyos. et sum. pil. camph. et opii. gr. vj. nocte.

5th. Slept well. Took two pills.

6th. Recurrence of paroxysm similar to those of March 10th, and nearly as severe.

℞. Spirit. æth. nitros. ʒ ss.
Tr. oppi, ʒij. M.
Cujus cap. ʒj. quaque hora, ad allev. doloris.

7th.

Habet. baln. tepid. nocte.
Sum. sol. mag. sulph. ʒ iv. crass mane.

11th. Advised to lay aside the use of medicines, to go into the country as soon as he is able, have two issues on the back, and use no hard water. Have all his food boiled in soft water.

Upon the 12th, the weather being fine, and he thinking his strength sufficient to leave the Hospital, he was discharged. Some cause prevented his going that day, however, and on the 13th the paroxysms recurred a third time, with the additional symptom of pain in the back. Had an injection, from which two dejections, one copious.

14th.

Sum. inf. senn. comp. ʒ ij. et post horas sex, enema si opus sit. Si dolor redeat, appl. foment. tanacet. et absinth. parti affectæ.

℞. Spirit. æth. nitros. ʒ ss.
Ol. junip. gtts. xxx. M.
Cujus cap. gtts. xxx. tertia quaque hora.
Omitt. pil. hodie.

15th.

Si dolores. red. appl. empl. canth. dig. iv. ad vj.

16th. This morning in a state of stupor. Answers questions with difficulty, and incorrectly. Loss of memory. This state continued till eleven or twelve o'clock, when he recovered, and soon after left the Hospital.

In about three days after leaving the Hospital, he died.

Examination April 24th, the day after death.

Slight adhesion of the omentum to the muscles on the left side. Left kidney considerably enlarged, with decided appearances of inflammation on exterior surface, covered with whitish spots, softer than natural. In the interior, appearances of inflammation much greater. Various ulcerations were discovered in the pelvis of the kidney, six or eight in number, and situated in the infundibula, and mamillary eminences. Ureter on this side enlarged to above four times the natural size, parietes very much thickened, and passage larger than natural. Right kidney larger than natural, with appearances of inflammation and spots of ulceration, but less than on the left side. Ureter enlarged. Bladder very small, its parietes much thickened; mucous coat of an ash color, with streaks of vermillion, and interspersed with numerous black dots. Prostate gland small, with no appearances of disease. Two singular appendages to the spleen, of the same substance with that organ, of the appearance of small lobes.

REMARKS.

On the last case I would remark, that when the patient first presented himself to me, I had a strong expectation of finding a stone in the bladder; his symptoms, as described to me, being very similar to those of the latter affection, with the exception of the sudden obstruction of the urine while passing, which he had not. When I attempted to pass an instrument, an obstruction presented itself in the membranous part of the urethra. This was removed in a few days without any mitigation of the symptoms, and the examination of the bladder was made, but no stone discovered. I then examined the prostate gland. This was found quite natural in feel, though smaller than usual. Having disposed of the suspicion of these complaints, I next directed my attention to the state of the urinary bladder. On examining externally, in different directions and situations, especially over the pubes, no tenderness could be discovered. There was however occasional pain above the pubes, a little to the left side; and the passage of an instrument into the bladder demonstrated an excessive tenderness in the internal coat of this organ. On repeated observations, I was not satisfied that an inflammation of the mucous membrane of the bladder in a patient of this age, could assume the obstinate character manifested by this complaint: and reflecting that the disease began with a violent pain in the back, I became satisfied that the original seat of it was the kidneys; and this inference was drawn perhaps as much from negative, as positive signs. The opinion was then stated to those who visited the patient with me.

On examination of the body after death, I proceeded in the first instance to the left kidney, which was as I had believed in a diseased state; though the extent of disease was much less than might be expected from such severe and fatal symptoms. The mucous coat of the bladder was clearly in a state of chronic inflammation; but its

condition would by no means justify the suspicion of its being the principal seat of disease. We conclude that the disease of this young man began in the kidneys, and was the effect of an injury operating on a delicate and irritable habit.

When we consider the general aspect of the cases related, we must be struck at first view with the intensity of the symptoms. In this respect the affection does not correspond with the other derangements of these organs, so far as they have been discriminated. A sudden enlargement of the prostate gland, which sometimes takes place in middle aged persons, and might, in opposition to the chronic disease of old age, be called sub-acute inflammation of the prostate, is accompanied by most violent and distressing symptoms; but they are easily discriminated to be the symptoms of affection of this gland, and moreover, an examination will show the gland in a very uncommonly enlarged state. The existence of a stone in the bladder is also accompanied by very severe symptoms; but they may be distinguished from those of the disease of which we are speaking, by being less constant.

This character of intensity will therefore lead to a suspicion of affection of the kidneys.—From other diseases occurring in the urinary organs it may be distinguished also.

First. From structure in the urethra, by the want of pus in the urine in stricture; by the narrowness and obstinacy of the contraction; and by the great length of time usually required for the formation of the structure. It must be noticed, however, that in disease of the kidneys there is often a sympathetic contraction of the urethra, which misleads the surgeon to the opinion that the complaint is stricture. But in this case the contraction will be found to vary extremely, sometimes to disappear and afterwards show itself anew in its original state. There are frequently mistakes committed in examinations for structure. Many a patient has been subjected to the action of a caustic, because a plaster bougie would not pass; when if a metallic cathetre had been employed, the largest instrument would have freely entered the bladder. Before deciding on the nature of one of these cases, every kind of instrument should be employed, and at different periods.

Second. Disease of the kidneys may be distinguished from enlargement of the prostate gland by examination. To form a correct judgment in this case, the surgeon must be much in the habit of making examinations of this gland in its healthy and morbid state.

Third. From chronic inflammation of the bladder it will be extremely difficult to distinguish this affection of the kidneys. There is however, I suspect, reason to doubt whether chronic inflammation of the bladder does frequently occur as a primary disease. Perhaps it may be for want of observation, or from want of a sufficient number of dissections; but I do not recollect a case of chronic inflammation of the mucous membrane, as a primary and uncomplicated disease. In the cases of ulceration of the kidney, however, this coat

has always exhibited signs of severe inflammation after death, and sometimes during life. A question may arise whether the inflammation of the mucous coat were a primary or secondary affection in the diseases of the kidney. I cannot doubt for a moment that the ulceration of the kidney is the original disease, and that the mucous coat is affected secondarily. The case of simple chronic inflammation of the mucous coat of the bladder, will be attended with symptoms less violent and less obstinate than the disease of which we are speaking. It might be thought that the pain in the back would serve to distinguish the affection of the kidneys from that of the bladder. But this pain is not so prominent a symptom as might be expected. In the case of Fessenden it scarcely existed except in the beginning of the disease.

Fourth. This disease will be distinguished from stone in the bladder by examination; and also by the sudden stop of the flow of urine, by the stone falling on the orifice of the urethra.

Symptoms of the disease. The disease sometimes begins with a pain in the back, but not uniformly. This is followed by an increased desire to pass water, which is done very often and in small quantities. As the disease advances this disposition becomes excessive, and much greater than what is known in other affections of these parts, frequently more than sixty times in twenty-four hours. The urine is slightly tinged with blood, and mixed with mucous. This mucous is afterwards purulent; or rather there is a mixture of blood and foul pus in variable proportions, sometimes the one and sometimes the other predominating. The pain is often excessive. Sometimes it is in the course of the urethra, accompanied by a violent burning; sometimes in the extremity of the penis as in the stone, and frequently in the lower part of the abdomen, in the middle or one side. The passage of an instrument into the bladder produces great pain. The pulse is accelerated, and tongue furred, though in a changeable manner. Sometimes there are regular paroxysms of fever, preceded by chills. The constitution becomes greatly disabled. Exhalations take place in the cellular membrane. The nervous system is disturbed. Under these distressing symptoms the patient survives for a considerable time.

Treatment. Whether this disease is ever curable I know not. I have a patient who has been ill three years, and for some time lay in a hopeless condition. He is now able to walk, ride, eat and drink, as usual; yet I cannot say he is well.—In the beginning of the complaint it would be proper to take blood from the arm, afterwards to apply leeches frequently to the loins and the perineum. The warm bath is useful. Mucilaginous injections into the rectum, with the addition of tincture of opium, when the pain is severe. Deep issues should be made with caustic, on each side of the spine; or on one side only if the disease seems to be confined to one kidney. Mucilaginous drinks, especially decoction of flaxseed, drank very copiously, give more direct ease than any other remedies taken into the

stomach; for in general, medicines passed through the stomach appear to have no great influence on the complaint. All stimulants are injurious. The balsams therefore do harm Injections into the bladder, however mild, are pernicious. The patient's regimen should be of the mildest kind; he should avoid the use of spring water, and employ only pure water, either distilled or rain water. Finally, the symptoms must be mitigated by the constant use of opium. Hyoscyamus, stramonium and hemlock, do not appear to be substitutes for this medicine.

REVIEWS

ART. III.—1. *An Exposition of the Natural System of the Nerves of the Human Body. With a Republication of the Papers delivered to the Royal Society, on the Subject of the Nerves. By Charles Bell, Professor of Anatomy and Surgery to the Royal College of Surgeons, &c. &c.* London. 1824.

2. *Appendix to the Papers on the Nerves, republished from the Royal Society's Transactions. By Charles Bell. Containing Consultations and Cases illustrative of the Facts announced in these Papers.* London. Longman & Co. 1827.

The Edinburgh Review for May, 1828, contains a long and elaborate article on the discoveries of Mr. Charles Bell; omitting its more declamatory parts, we present our readers with that portion which sets forth the nature and extent of those discoveries.—ED.

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It is singular enough that this happy conjecture of so extraordinary a man should have been entirely overlooked, until the proofs of its truth were brought forward in Mr. Bell's experiments in 1809; for examples of diseases were daily occurring, in which sensation or motion were *separately* lost; and the mere condition of sleep showed the suspension of one set of nervous offices, and the continuance of others,—whilst the actual division of a nerve going to the extremities, took away both motion and sensation. That there were some nerves merely for sensation, and some only for motion, was, however, generally discredited, at least up to the time of Haller. If motion was lost without there being also loss of sensation, the reason was, according to Haller himself, that sensation could exist with less remaining strength than motion could! and the condition of the dying, who lost the power of moving before the power of feeling left them, was adduced as an example. This notion was allied to, if not absolutely identical with, the hypothesis of the nervous action in motion and sensation being, in kind, precisely the same, and differing only *in force*. Of those who admitted the possibility of one nerve containing distinct fibres for each of these two offices, some supposed that the conducting faculty, with relation to external and internal impressions, resided in a different substance, as that of internal impressions in the medullary, that of external impressions in the neurilemma; but many were indisposed to acknowledge the necessity for that which they conceived might be regulated in the brain

or nervous centre, and for which the fibres of the nerves exhibited no visible preparation. It was urged also, that as muscular fibres could be contracted in opposite directions, so in like manner might the fibres of the same nerves convey impressions from within outwards, and from without inwards. We may here remark the curious mistake of the elder anatomists concerning the ganglions, a matter on which they affected a particular exactness, and concerning which, for the most part, they agreed. They thought the proper office of the ganglions was *to cut off* sensation from the portion of the nerve below it; it will presently be seen that the truth is diametrically opposite; and that Mr. Bell has shown all nerves of sensation to be provided with and distinguished by a ganglion.

While these obscurities continued to beset the functions of sensation and motion, there was naturally no great accord among physiologists concerning what they choose to call vitality, and animality, or concerning the distinct offices of the cerebrum and the cerebellum, or the difference between nerves of voluntary and involuntary muscular motion. The spinal marrow was considered as a simple chord, medullary without, cineritious within, giving origin to the nerves; and the curious intercostal, or sympathetic system, was sometimes asserted to be the centre of organic, nutritive, or automatic life, and sometimes regarded as hardly more than an elaborate contrivance for the propagation of sympathies among all parts of the body; between the intellect and the stomach, between the body and the mind, between one side of the body and the other, and interchangeably among all the separate organs.

Such, so vague, so obscure, so inexact, so unsatisfactory, was the kind of knowledge communicated to the student, until a very recent period; and the impression left by it was, that of confused and unintelligible profusion in the distribution of nerves, of intricacy without meaning, of an expenditure of resources without a parallel in the other works of nature. But no small part of this confusion is now made clear; what seemed to be profusion, has been shown to be a provision equally wise and economical for the perfect performance and combination of the most important and distinguishing functions of living creatures. We do not mean to speak here of the proposed location of different mental faculties in different parts of the brain, an idea which the Arabians held in their schools, and which, with many additions, has lately excited so much attention, because that theory has not yet been subjected to the kind of investigation by which its truth must finally be judged. It can hardly be said to admit of experiment, and pathological facts have scarcely yet been viewed in connexion with it. It must be confessed, indeed, that the structure and uses of the brain itself, of its eminences, cavities, divisions, and junctions, are yet among the things least understood, and still remain to be explained by some living, or some future physiologist; and many ingenious hypotheses will doubtless arise and fall, before conjecture points with any certainty to the reason of all

the forms and modifications of the cerebral substance. Minute observaton of structure, and the cautious investigation of morbid phenomena, must be chiefly depended on for the elucidation of these circumstances, for here also experiment can seldom, perhaps never, be applied in aid of them. But discoveries of the highest value *have been made* in all that relates to the origins and functions of the Nerves themselves, arising from portions of the cerebrum, and from the spinal marrow; and have sprung so legitimately from anatomical investigation, have been so judiciously and so clearly illustrated by experiment, and so supported by observation of cases of disease, as to have laid a foundation, which may be enlarged or strengthened by the future progress of science, but can never be shaken or rendered insecure. Of these discoveries, so difficult in their nature, and in their practical, as well as philosophical consequences so important, the works of which the titles are prefixed to the present article, present abundant evidence, that the chief honor belongs to Mr. Charles Bell.

Previous to the publication of his Exposition of the Natural System of the Nerves, several eminent physiologists had instituted researches into different parts of this system; but the results had been less satisfactory than might have been expected from the zeal and intelligence with which they were conducted. We would by no means speak slightingly of labours most honorable to those engaged in them; yet, assuredly, it is embarrassing to those who, not being practical physiologists themselves, humbly await the discoveries of those who are, to find, after reading no small number of volumes, including the details of innumerable experiments, that by one the ganglions were looked upon as so many little brains, between which the great intercostal, or sympathetic nerve, was the chain of communication for interior life, while others considered them as cutting off the course of sensation; that by one the power of the heart, stomach, and intestines, was wholly ascribed to the spinal marrow, and by another stated to be quite independent of it; that by one the secretions were placed under the agency of the nerves, and by the experiment of another shown to be very little influenced by them.

Mr. Bell's researches have been directed more exclusively to the principles of a just and natural arrangement of the nerves, called cerebral and spinal, and to the investigation of their particular offices; and in the progress of them he has established facts, analogies and classifications, of singular value and interest.

The history of these scientific labours presents so instructive an example of the means of establishing presumed truths, and has, moreover, so much connexion with certain consequences of another kind, which we shall have to notice, that we must begin our review of what he has done for this department of anatomy and physiology, by reverting to a pamphlet circulated by him among his friends so long ago as in the year 1809, and entitled, "Idea of a new Anatomy of the Brain." In justice, it ought to be stated, that this pam-

phlet was never published; but was distributed among Mr. Bell's friends, for the professed purpose of eliciting objections to the course of study which he found himself then taking, and which he foresaw would, in all probability, employ the better part of his life. He wished either to be encouraged, or to be convinced that he was wrong; and notwithstanding that it contains more than the rudiments of those discoveries which we have now to explain, it seems to have excited very little attention; and twelve years of unassisted labour elapsed before Mr. Bell appeared before the public. During all that time, however, he was engaged in teaching, and each year in which he came to the discussion of nerves, was marked by improvement. An opinion then prevailed, and is probably not yet quite extinct, that the different sensations conveyed by different nerves, resulted solely from the *superior delicacy* of one set of them above the other. If the optic nerve conveyed sensations of light and colour, this was only because its terminations were, of all nervous expansions, the finest and most minute. One answer may perhaps suffice for this extravagant hypothesis. If varieties of sensation depended on gradations of nervous subtlety, any decrease in this quality would produce not the impairment of the sensation usually conveyed by the nerve so affected, but a substitution of another sense in lieu of it. If the nerve of sight was so affected, the eye would be metamorphosed into the organ of hearing or of simple touch; or in other circumstances, the sense of hearing might degenerate into that of taste. But the truth is, that the theory has no foundation in fact: for the tenuity of expansion of the nerves of hearing, or taste, or touch, has never been proved to be less delicate than that of sight itself; and however varied the impulse or agent affecting a nerve, the impression always takes its character from that of the nerve itself. Mr. Bell, however, soon applied himself to the correction of more formidable errors: and attacking the common opinion, that a separate sensation and volition are conveyed by the same nerves, he asserted the functions of different parts of the cerebrum and cerebellum, and maintained that a great part of the nerves were not single nerves possessing various powers, but bundles of different nerves, the filaments of which were united for the convenience of distribution, but yet as distinct in their office as in their origin; that the perception or idea depended on the part of the brain to which the nerve was attached; and that the matter of the nerves of the external organs of sense was adapted to the reception of certain impressions only: further, "That the nerves of sense, the nerves of motion, and the vital nerves, are distinct through their whole course, though they seem sometimes united in one bundle; and that they depend for their attributes on the organs of the brain, to which they are severally attached."

We find Mr. Bell strongly insisting, in this pamphlet, on the complete distinctness of the cerebrum and cerebellum; and pointing out the distinction, (which afterwards led him to other distinctions of

great moment,) that although the two hemispheres of the brain were so like in form and substance, and so united by tracts of medullary matter, as to make consentaneousness of office both probable and easy, the cerebrum and cerebellum were, on the contrary, very different both in form and arrangement, and but slightly and indirectly connected; adducing facts at the same time which showed that these parts might be separately affected; and, finally, deducing from these observations the conclusion of their being distinct in office. This conclusion was strengthened by reference to the varying proportions of the cerebrum and cerebellum in different classes of animals, the diversity of the former in creatures differently endowed, and the general permanency of character in the latter. It is of much consequence, as will hereafter be evident, to quote in this place Mr. Bell's own description of his attempts to prove by experiment what he had suceeeded in making so probable by reasoning:—

"I took this view of the subject. The *medulla spinalis* has a central division, and also a distinction into anterior and posterior fasciculi, corresponding with the anterior and posterior portions of the brain. Further, we can trace down the crura of the *cerebrum* into the anterior fasciculus of the spinal marrow, and the crura of the *cerebellum* into the posterior fasciculus. I thought that here I might have an opportunity of touching the *cerebellum*, as it were, through the posterior portion of the spinal marrow, and the cerebrum by the anterior portion. To this end I made experiments, which, though they were not conclusive, encouraged me in the view I had taken.

'I found that injury done to the *anterior* portion of the spinal marrow convulsed the animal more certainly than injury done to the posterior portion; but I found it difficult to make the experiment, without injuring both portions.

'Next, considering that the spinal nerves have a *double* root, and being of opinion that the properties of the nerves are derived from their connexions with the parts of the brain, I thought that I had an opportunity of putting my opinion to the test of experiment, and of proving at the same time, that nerves of different endowments were in the same cord, and held together by the same sheath.

'On laying bare the roots of the spinal nerves, I found that I could cut across the posterior fasciculus of nerves, which took its origin from the posterior portion of the spinal marrow, without convulsing the muscles of the back; but that on touching the anterior fasciculus with the point of the knife, the muscles of the back were immediately convulsed.

'Such were my reasons for concluding that the cerebrum and the cerebellum were parts distinct in function, and that every nerve possessing a double function, obtained that by having a double root. I now saw the meaning of the double connexion of the nerves with the spinal marrow; and also the cause of that seeming intricacy in the

connexions of the nerves throughout their course, which were not double at their origins.

'The spinal nerves being double, and having their roots in the spinal marrow, of which a portion comes from the cerebrum, and a portion from the cerebellum, they convey the attributes of both grand divisions of the brain to every part; and therefore the distribution of such nerves is simple, one nerve supplying its destined part. But the nerves which come directly from the brain, come from parts of the brain which vary in operation; and in order to bestow different qualities on the parts to which the nerves are distributed, two or more nerves must be united in their course or at their final destination.—Hence it is, that the first nerve must have branches of the fifth united with it: hence the *portio dura* of the seventh pervades everywhere the bones of the cranium to unite with the extended branches of the fifth: hence the union of the third and fifth in the orbit: hence the ninth and fifth are both sent to the tongue: hence it is, in short, that no part is sufficiently supplied by one single nerve, unless that nerve be a nerve of the spinal marrow, and have a double root, a connexion (however remotely) with both the cerebrum and cerebellum.'

In this passage we see laid open the very foundation of all Mr. Bell's important discoveries relating to the functions of the nerves: it being perfectly clear that he was then aware of the distinct offices of the anterior and posterior portions of the spinal marrow; and that the nerves arising from its anterior part were for Motion, and those of the posterior were for Sensation, or for some other office; for there was much difficulty in proving the latter circumstance by direct experiments, in consequence of the general shock communicated; but the fact was afterwards proved by experiments made on the functions of the fifth nerve. It is no less clear that Mr. Bell then understood that the nerves proceeding from the brain had each but a single function, and required to be united with some other nerve when a double function was to be effected: and although it was in consequence of these investigations, and from the discovery of this general principle of combination of separate nerves for combined offices, that he was led to the understanding of the extensive system of nerves connected with the complicated actions of respiration; yet this is precisely the part of Mr. Bell's labours, concerning which justice has been most withheld from him. His incontestable discovery of the distinct functions of the spinal nerves has been claimed by others; and those who seem most disposed to pronounce fairly on this matter in another country, where the claim has been most directly advanced, and would at least allow Mr. Bell a share of the merit of priority, rest his title to it, curiously enough, on the *probability* of his having been naturally led to the discovery *by* his researches into the system of the respiratory nerves; whereas the truth is, that these researches, with all their consequences, were *the result* and not *the cause*, of his having discovered the principle on which the spinal nerves of motion and sensation were

distributed. It was, beyond all question, by the light of this principle that he was directed to the conclusion, that the nerves of an organ were complex only because its functions were complicated. Putting aside the mere evidence of dates, there is proof enough of Mr. Bell being the first discoverer, from the course of his progress. We see, first, the observation of structure, leading him to infer the distinct functions of the different roots of the spinal nerves; and then the inconvenience of the experiments directly proving it, causing him to trace analogical double structure in some of the cerebral nerves, and to select the fifth, of which he succeeded in showing the double office. Subsequently to this, we observe him still seeing more nerves sent to parts already supplied with nerves both of motion and sensation, and led to investigate their uses; and finally, by experiment, by comparative anatomy, and pathological phenomena, ascertaining the separate and *superadded* system of respiratory nerves, so denominated by him with an obvious reference to the previously ascertained nature of the *regular* nerves of sensation and of motion. Every step of this process is plain and orderly, and it would be difficult to find a more admirable example of useful discovery philosophically attained. It is enough, for the present, to have pointed out the singular perversity of fortune by which Mr. Bell's persevering and patient pursuit of a great principle, and his meritorious abstinence from premature assertion, had almost deprived him of the credit which so truly belongs to him.

Although, from circumstances, it has become necessary to trace Mr. Bell's discoveries back to this pamphlet, it is proper to remark, that the observations on the brain and the roots of the nerves, were not the commencement of his labours. It was the seeming *complication* in the course of the nerves, as they wander over the head, the neck, and the chest, that first led him to this investigation.—When he was directing our attention to the columns of the spinal marrow, and the double roots of the nerves, he was in fact explaining that intricacy, which he found in the distribution of the nerves, and which had met him each time he returned to the demonstration of the subject in his public lectures. So that he has, in fact, arrived at his conclusions by two different paths,—1st, by observing the distribution and relation of the nerves in their remote extremities; and, 2d, by observing the columns of the brain and spinal marrow, and the origins of the nerves from these columns.

Before following the order of Mr. Bell's papers, it may facilitate the comprehension of the whole subject to state, as he himself has done in his preliminary observations, that according to the views he takes of the nerves of the human body, there are, besides the nerves of vision, smell, and hearing, *four* different systems of nerves distributed through the body; those, namely, of Sensation, of Voluntary Motion, of Respiratory Motion, and those which, neither communicating sensation in the ordinary meaning of that term, nor conveying the volition which directs voluntary motion, nor yet respiratory,

unite the body into a whole, and are essential to Nutrition, to growth, to decay, and generally to animal existence. The nerves of these separate functions are undistinguishable by their structure, but known by their origins, they are sometimes separate in their course, sometimes bound together in one sheath; but never, as had been formerly supposed, confounded in office. They are divided into simple nerves and compound; the first having their roots arising in a line, or sequence, from the brain or spinal marrow, as seen in the ninth nerve; the roots of the second arising in *double* rows, each row from a *different* column or tract of nervous matter, as exemplified in the nerves arising from the spinal marrow.

'If we were successfully to trace a nervous cord, (we shall suppose from a muscle of the fore-arm,) it would be found a simple filament, thread, or funiculus. We should then trace it into a compound nerve; perhaps the ulnar nerve, which we call compound, because there are in it filaments of motion, and filaments of sensation bound together. At the root of the auxiliary nerve we should trace it into the composition of a fascis, where it forms the anterior root of a spinal nerve. Being further traced, it would merge in the anterior column of the spinal marrow; and traced into the base of the brain, it might be followed as a *tractus*, a streak of matter distinguishable from the surrounding substance, until it was seen to disperse and lose itself in the cineritious matter of the cerebrum. In all this extent, however combined or bound up, it constitutes one organ, and ministers to one function, the direction of the activity of a muscle of the hand or finger. Even in this respect its operation is not perfectly simple, for while it excites the muscle to change its state, which we call its state of contraction or of relaxation, it also conveys to the sensorium a sense of the condition of that muscle.

'And so, if we trace other fasciculi, or rather filaments, whether they be for the purpose of sensation or of motion, each retains its office from one extremity to the other; nor is there any communication betwixt them, or any interchange of powers, further than that a minute filament may be found combined with filaments of a different kind, affording a new property to the nerve thus constituted.'

Mr. Bell describes the spinal marrow as being composed in reality of six columns, or three in each lateral portion; an *anterior* column, which is for the function of Voluntary Motion, and may be traced into the substance of the brain; a *posterior* column for Sensation, and a third, or lateral, column, between the anterior and posterior columns, and which is for the Respiratory functions. The existence of this last had been pointed out by other anatomists; but Mr. Bell was the first clearly to describe it, or to point out its peculiar use. Each of these columns has subdivisions, not yet explained. This arrangement of the spinal marrow prevails in all the vertebrated animals; and is indispensable to the association and combination

of all the movements connected with the act of respiration in those possessing a thorax capable of respiratory motions.

To speak first of the *regular* nerves, there are of these thirty sent out from the spinal marrow on each side; and each of these has two distinct roots, one from the anterior and one from the posterior column. The *posterior* root of each is distinguished by a ganglion, situated where it is surrounded by the sheath of the spinal marrow, and before its junction with the anterior root. Seeing this great regularity of the spinal nerves, and the very great irregularity of the cerebral nerves, Mr. Bell was led to inquire into the reason of so remarkable a contrast; whether, first, the double office of these nerves depended on their having double roots; and whether this was the cause of their peculiar simplicity of arrangement: and, secondly, what cerebral nerves, in their distribution to the head and face, had similar offices.

'It was necessary to know, in the first place, whether the phenomena exhibited on injuring the *separate* roots of the spinal nerves correspoded with what was suggested by their anatomy. After delaying long on account of the unpleasant nature of the operation, I opened the spinal canal of a rabbit, and cut the posterior roots of the nerves of the lower extremity; the creature crawled, but I was deterred from repeating the experiment by the protracted cruelty of the dissection. I reflected, that an experiment would be satisfactory, if done on an animal recently knocked down and insensible; that whilst I experimented on a living animal, there might be a trembling or action exerted in the muscles by touching a sensitive nerve, which motion it would be difficult to distinguish from that produced more immediately through the influence of the motor nerves. I, therefore, struck a rabbit behind the ear, so as to deprive it of sensibility by the concussion, and then exposed the spinal marrow. On irritating the posterior roots of the nerve, I could perceive no motion consequent, on any part of the muscular frame; but on irritating the anterior roots of the nerve, at each touch of the forceps there was a corresponding motion of the muscles to which the nerve was distributed. These experiments satisfied me that the different roots and different columns from whence those roots arose, were devoted to distinct offices, and that the notions drawn from the anatomy were correct.

'The anterior roots of the spinal nerves, and the anterior column of the spinal marrow, being thus shown to have a power over the muscular system, the next step of the inquiry was distinctly indicated. If I pursue the tract of the anterior column of the spinal marrow up into the brain, shall I find the nerves which arise from it to be muscular nerves? An anatomist will at once answer, that only muscular nerves arise in this line.'

Mr. Bell's descriptions are materially aided by drawings and plans; but those who are acquainted with anatomy will remember,

that on tracing up the anterior column of the spinal marrow into the corpus pyramidale, the ninth nerve is found to arise from it, having *one* series of roots only, corresponding with the anterior roots of the spinal nerves, and that this nerve is a nerve of Motion, entirely devoted to the muscles of the tongue, and unconnected with the sense of taste. Higher up, arising from the same *tractus motorius*, is the sixth nerve, a muscular nerve of the eye; and higher still, tracing the tractus through the Pons Varolii, are the roots of the third nerve, the motor nerve of the eye. These interesting points being ascertained, it remained to be seen whether the posterior column of the spinal marrow, and the roots proceeding from it, were for sensation. Pursuing this inquiry, it was found that the fifth nerve the sole nerve of sensation in the head and face; and it was thence understood why there was no necessity for the third, sixth, and ninth nerves having a posterior or ganglionic root. Thus far the fifth nerve agreed with the spinal nerves in bestowing sensation: It then became a question whether it had a further resemblance to them, and comparisons being instituted, both in man and in brutes, of the anatomy of this nerve and of the spinal nerves, a remarkable similarity was discovered. It was seen, like the spinal nerves, to have *a double root*, the anterior root passing the ganglion, and the posterior falling into the ganglion; and on following back the anterior root, it was observed to come out between the *funes* of the pons varolii, and, in fact, from the crus of the cerebrum. And as the anterior portion of the nerve did not enter the ganglion, Mr. Bell conceived it to be, in fact, the uppermost nerve of the spine, the uppermost of that series of nerves which are both for motion and for sensation. To ascertain the correctness of this conclusion, the nerve was exposed at its root, in an ass just killed, and being irritated, 'the muscles of the jaw acted, and the jaw closed with a snap.' The nerve was next divided in a living animal, and the jaw was found to fall.—These experiments left the functions of the nerve no longer a matter of doubt, and proved it to be both a muscular nerve and a nerve of sensibility; in short, to be, for the head, what the spinal nerves are for the other parts of the body.

The *regular* nerves, then, are the seven cervical, the twelve dorsal, the five lumbar, the six sacral, the sub-occipital, and the fifth pair, and all these nerves, which are for sensation and motion, are *double* in their origin; and they are common to all animals, 'from the worm up to man.' The *irregular* nerves, so designated from the irregularity of their distribution, have *a single* root, and are superadded to those just spoken of, according to the complication of organs for which they are intended; such are the third, fourth, and sixth nerves going to the eye; the seventh, to the face; the ninth, to the tongue; the glossopharyngal, to the pharynx; the nervus vagus, to the larynx, heart, lungs, and stomach; the phrenic, to the diaphragm; the spinal acessory, to the muscles of the shoulder; and what Mr. Bell has named the External Respiratory, a nerve resem-

bling the phrenic of its origin, but sent to the outside of the chest, to the serratus magnus muscle, which muscle is also supplied from the regular system of nerves All these irregular nerves are, we have said, using Mr. Bell's words, *superadded*, and for superadded organs; and this superaddition of organs he has shown to be such as are connected with the apparatus of respiration, and the variety of offices for which this apparatus is prepared in the higher animals. It is this explanation which gives clearness to a piece of anatomy, formerly of all the most difficult and confused, and which enables us to account for the apparent prodigality, for the countless ramifications, for the numerous connexions of the nerves of the face, neck, and chest; more particularly of the fifth and seventh nerves with the ninth, and with the cervical and phrenic nerves.

The motions connected with respiration, although chiefly seen in the neck, trunk, and face, extend almost all over the body, to some hundred muscles, as is evident during any of the more violent respiratory efforts. Here, then, are new motions, differing wholly from those of which the end is locomotion, and no less from the voluntary motions, and therefore presumably requiring a new source of nervous energy. Of these motions, some are well known to be under the command of the will, others carried on independently of the will, and not to be controlled for any long time by the strongest effort of volition, but still carried on by the same muscles, both when we will, and when we do not. Thus we breathe during sleep without volition, and yet we can use the respiratory muscles as voluntary muscles in violent exertions, or in singing. Hence there is an evident necessity for *a combination* of powers; and from this combination arises a necessary degree of complexity in the system of nerves connected with those powers. Mr. Bell has illustrated this very clearly:—

'Let us observe, in the act of eating and swallowing, the necessary combination of the three powers of sensation, voluntary muscular activity, and the act of the respiratory muscles. If we cut the division of the fifth nerve which goes to the lips of an ass, we deprive the lips of sensibility; so when the animal presses the lips to the ground, and against the oats lying there, it does not feel them; and consequently there is no effort made to gather them. If, on the other hand, we cut the seventh nerve where it goes to the lips, the animal feels the oats, but it can make no effort to gather them, the power of muscular motion being cut off by the division of the nerve. Thus we perceive that in feeding, just as in gathering any thing with the hand, the feeling directs the effort, and two properties of the nervous system are necessary to a very simple action.

'In drinking, the fluid is sucked in by the breath, and when the mouth is full we swallow. The water is felt; the lips are moulded into the right form by volition, and the muscles of inspiration combine to draw in the fluid. In the act of swallowing, the liquid

would descend into the windpipe, were there not a combination of the muscles of respiration with the apparatus of deglutition to prevent it; nor could the fluid or the solid morsel pass the diaphragm without a similar coincidence of activity and relaxation betwixt parts animated by different systems of nerves.

'In speaking, it is still more obvious that the act of respiration must become voluntary, in order to push out the breath in combination with the contractions of the larynx, and tongue and lips, for producing sound, and more especially articulate language.

'The respiratory system must be exercised under an instinctive and involuntary impulse, as in breathing during sleep and insensibility. But it must, at certain times, be associated into voluntary actions. By foreseeing this difficulty, we shall avoid the danger of pushing the investigation of the anatomy too far, or of throwing a doubt over important discoveries by attempting too much.'

It was fortunate for Mr. Bell's investigations, that the face was a part of the body in which the nerves of voluntary motion and of sensation, which in other parts of the frame ran their course bound up together, were distinctly and separately distributed, coming out from the cranium through separate openings, and meeting only in their terminations. This arrangement enabled him to make those decisive experiments to which we have already alluded.

We have before said that our author had contrasted the spinal nerves, which are remarkable for their regularity, with the nerves of the brain, which are irregular both in their origin and course. The former arise uniformly from prolonged tracts of medullary matter, and have each *two* roots and a ganglion upon one, and they are distributed universally over the body. The nerves of the brain arise from distinct parts, and their roots are *single*, with the exception of one, which is the fifth. We find that this has *two* distinct origins, and also a ganglion upon one of them—that it corresponds, in fact, with the extensive class of spinal nerves. Here there is a remarkable circumstance demanding explanation: when we find a spinal nerve introduced in the midst of so many others, it points out distinctly that the spinal nerves must have some peculiarity of function. The fifth nerve was found, accordingly, to be both a nerve of motion and of sensibility, as all the spinal nerves are. But the question then arose, what necessity is there for another nerve of motion being supplied to the muscles of the face, where the fifth is already distributed? This can only be answered by attending to the peculiar functions performed by these muscles, and observing how they are connected with the complex actions of respiration, as may be seen in simple breathing, or speaking, and expression. It would thus appear that the fifth pair is not suited for controlling these actions, but that a new nerve having a different origin from the brain is required. All these circumstances being considered, Mr. Bell was prepared to decide by experiment whether the fifth and seventh

afforded a double supply of the same kind of endowment, or performed different offices.

'An ass being thrown, and its nostrils confined for a few seconds, so as to make it pant and forcibly dilate the nostrils at each inspiration, the portio dura was divided on one side of the head; the motion of the nostril of the same side instantly ceased, while the other nostril continued to expand and contract in unison with the motions of the chest.

'On the division of the nerve, the animal gave no sign of pain; there was no struggle nor effort made when it was cut across.

'The animal being untied, and corn and hay given to him, he ate without the slightest impediment.

'An ass being tied and thrown, the superior maxillary branch of the fifth nerve was exposed. Touching this nerve gave acute pain. It was divided, but no change took place in the motion of the nostril; the cartilages continued to expand regularly in time with the other parts which combine in the act of respiration; but the side of the lip was observed to hang low, and it was dragged to the other side. The same branch of the fifth was divided on the opposite side, and the animal let loose. He could no longer pick up his corn; the power of elevating and projecting the lip, as in gathering food, appeared lost. To open the lips the animal pressed the mouth against the ground, and at length licked the oats from the ground with his tongue. The loss of motion of the lips, in eating was so obvious, that it was thought a useless cruelty to cut the other branches of the fifth.

'The experiment of cutting the respiratory nerve of the face, or *portio dura*, gave so little pain, that it was several times repeated on the ass and dog, and uniformly with the same effect. The side of the face remained at rest and placid, during the highest excitement of the other parts of the respiratory organs.

'When the ass, on which the respiratory nerve of the face had been cut, was killed, which was done by bleeding, an unexpected opportunity was offered of ascertaining its influence, by the negation of its powers on the side of the face where it was cut across.

'When an animal becomes insensible from loss of blood, the impression at the heart extends its influence in violent convulsions over all the muscles of respiration; not only is the air drawn into the chest with sudden and powerful effort, but at the same instant the muscles of the mouth, nostrils, and eyelids, and all the side of the face, are in a violent state of spasm. In the ass, where the respiratory nerve of the face had been cut, the most remarkable contrast was exhibited in the two sides of its face; for whilst the one side was in universal and powerful contraction, the other, where the nerve was divided, remained quite placid.'

'The actions of sneezing and coughing are entirely confined to the influence of the respiratory nerves. When carbonate of ammo-

nia was put to the nostrils of the ass whose respiratory nerve had been cut, that side of the nose and face where the nerves were entire, was curled up with the peculiar expression of sneezing; but on the other side, where the nerve was divided, the face remained quite relaxed, although the branches of the fifth pair and the sympathetic were entire. The respiratory nerve of one side of the face of a dog being cut, the same effect was produced; the action of sneezing was entirely confined to one side of the face.

'On cutting the respiratory nerve on one side of the face of a monkey, the very peculiar activity of his features on that side ceased altogether. The timid motions of his eyelids and eyebrows were lost, and he could not wink on that side; and his lips were drawn to the other side, like a paralytic drunkard, whenever he showed his teeth in rage.'

'All that excitement seen in a dog's head, his eyes, his ears, when fighting, disappears, if this nerve be cut. The respiratory nerve being cut across in a terrier, the side of the face was deprived of all expression, whether he was made to crouch, or to face an opponent and snarl. When another dog was brought near, and he began to snarl and expose his teeth, the face, which was balanced before, became twisted to one side, to that side where the nerve was entire; and the eyelids being, in this state of excitement, very differently affected, presented a sinister and ludicrous expression.'

About a year after the communication of these facts to the Royal Society, Mr. Bell read a second paper in continuation of the same subject, but relating particularly to the nerves which associate the muscles of the *chest* in the actions of breathing, speaking, and expression. The extensive combinations into which these muscles enter may be conceived, by reflecting on the actions and offices of this portion of the body, which supports and protects the heart and lungs, as well as the viscera seated in the upper part of the abdomen, and produces, by alternate opposition and yielding to the atmospheric pressure, the action of respiration. In order to explain these actions, Mr. Bell found it necessary to draw attention to the muscles of the chest; observing particularly upon those which come from the shoulder bones, and from the head, and descend to the upper part of the chest, and in explaining how these muscles expand the chest, as in drawing breath, he proves that at the same moment the head must be raised, and the shoulders drawn back. Having thus shown by the review of the muscles, which of those on the fore part and of those on the back part of the chest, are necessarily combined in the act of drawing breath, he has paved the way for removing the whole intricacy of this part of the Nervous system: for to reach these respiratory muscles, the raspiratory nerves must take a devious course, turning and twisting, and threading through the nerves of sensation and voluntary motion. Taking one of these nerves, the spinal accessory, and dividing it, he found that the muscles supplied by it

were cut off from partaking in the act of breathing, whilst they retained their office under the other nerves; that is, could be used as voluntary muscles, when they no longer acted as respiratory muscles. To the spinal accessory nerve, therefore, Mr. Bell has given the name of Superior Respiratory; and he has ascertained that whilst the phrenic acts on the diaphragm in expanding the chest, the external muscles associated with the diaphragm are combined in such action by a similar provision of respiratory nerves; that what the phrenic, or internal respiratory, is to the diaphragm, the spinal accessory is to the muscles behind the neck and to the mastoidens, and the external thoracic to the muscles of the sides of the chest. The proofs of these opinions rest, like those of the office of the respiratory nerve of the face, on the origin and distribution of these nerves in the human subject, on the facts exhibited by comparative anatomy, or pathological phenomena, and on experiment. It has been seen that the spinal accessory arises, like the other respiratory nerves, from the lateral column of the spinal marrow. In fishes, which have no diaphragm, there are no phrenic nerves; nor are there any spinal accessory, or external thoracic, their muscular conformation not requiring any. The structure of the wing, and the absence of a mastoid muscle, render a spinal accessory nerve unnecessary to birds. Quadrupeds in general have all the three respiratory nerves of the trunk; but the camel, which is without a mastoid muscle, its neck and head being supported by a succession of muscles which are shorter and attached to the vertebræ, has no spinal accessory nerve.

By inquiring into the functions of the numerous distinct nerves which go into the parts surrounding the eye, Mr. Bell was led to observe the motions of the eyeball, with particular interest. The motions of the eye, consequently, became the subject of one of his papers, the third, read before the Royal Society, in which it was explained why no less than six nerves were sent to that organ, and crowded into a space so small as that of the orbit. The internal arrangements of this important organ of sense, have often furnished a pleasing subject of proper illustration, and are pretty generally understood; but what Mr. Bell terms 'the frame-work which suspends it, and by which it is covered and protected,' has been less attended to, though no less worthy of notice than the contrivances within the eye itself. Except when some part of this curious external apparatus is impaired, we seldom are aware of its great value. Paley was struck with the importance of the 'two little muscles that serve to lift up the eyelids,' by being acquainted with a gentleman who had lost the use of them, and was obliged 'to shove up his eyelids with his hands;' and there are other minute offices without the regular performance of which sight would be equally interfered with. Mr. Bell considers the motions of the eye in two points of view; with relation to mere vision, and with relation to the preservation of the organ. He has pointed out a peculiar revolving motion which had not previously attracted attention, and that the different conditions

of the retina are accompanied by appropriate conditions of the surrounding muscles; he has divided these muscles into two classes, one presiding over the organ when we use it, the other taking charge of it when we sleep, or during faintness and insensibility; and he has shown the deductions which may be drawn from these circumstances, in connexion with the appearances of the eye in disease, and as an organ of expression.

The revolving movement of the eye is that by which, when the eyelids are closed, the cornea, or transparent part, is raised under the upper lid, a movement easily verified by closing one eye and placing the finger over the eye-lid, so as to feel the ball of that eye, and then shutting the other eye, in which case the globe of the eye over which the finger is placed is felt to move upwards, as it is also perceived to descend when the other eye is opened again. The intention of this motion is thus explained by Mr. Bell. The margin of the eyelids is flat, and when the lids are closed, they meet only by the outer edge of this flat margin, and a gutter is left between them and the cornea; this part of the cornea, therefore, in the space or gutter so left, would never be touched or swept over by the eyelids, unless the eyeball shifted its place in the act of shutting the eye; and it would consequently become dimmed by a continual collection and accumulation of moisture there, exactly in the axis of the eye. This motion of the eye also facilitates the flow of tears from the lachrymal duct, and is performed so rapidly, the globe of the eye moving upwards whilst the lid moves downwards, that protection is instantaneously given in all emergencies to which so delicate an organ is exposed, and which its outward guards are not of themselves calculated to meet. The best illustration of this motion of the eye, and one which Mr. Bell has often pointed out to his pupils in the Middlesex Hospital, is afforded in some cases of partial paralysis; cases in which there is no loss of sensation, but in which the motion of the eyelids of one eye is lost, and the eyelids remain open; in these instances, whenever the unaffected eye is closed, whenever the patient winks, the eyelid of the paralyzed side of the face is unmoved, but the globe of the eye is at that moment lifted upwards, as if to get under the raised lid; and this circumstance, it may be observed, not only shows the revolving motion of the eye, but the dependence of that motion on a nerve not involved in the paralytic affection which deforms the face. Mr. Bell further observes, that during this rapid motion, the lower eyelids move also, and in a direction towards the nose; so that if both lids are marked, it may be seen, that, when the eye is shut and opened, the spot on the upper lid descends, and ascends perpendicularly, while that on the lower moves horizontally towards the nose and from it, 'like a shuttle.' So that we see the whole effect of the act of winking, an operation so instantaneous as to have formed the basis of a proverb from time immemorial, is, that the secretion of the lachrymal gland is promoted, and directed towards the duct along which it is to flow from the eye after washing

it, the upper eyelid descends and sweeps the eye; the globe of the eye is so moved, that the only part which could not be so swept is effectually cleared; and the under eyelid moves, so as to propel towards the outlet of the eye, at its inner angle, whatever has offended it, whatever would obscure or impair it, as well as the tears which have been used to wash these objects away. At the same time, the eye is relieved by the interchanges of muscular action which take place during this momentary action, and it is immediately protected when immediate protection is required.

These are but a small part of the proofs of design afforded by this single organ, contributing as it does so largely to the knowledge and the happiness of living creatures. In an examination of the works of Infinite power, we are always reminded of the benevolence with which it is combined, and of the limitation of our own conceptions. The larger works of the creation first attract our regard; we push our ambitious enquiries into the heavens, and are lost in ideas of space and magnitude, of rapidity and immensity of movement beyond the reach even of imagination. But if we look down into the smallest details of those works which are around us, or which are exhibited in the 'express and admirable' structure of our own frame, we are no less delighted by exquisite contrivance and delicacy of execution. The more we increase our means of acquiring a knowledge of the larger features of the universe, the more we are impressed with the greatness of the power which sustains and directs so stupendous a work; and the more minutely we pursue researches which our unassisted senses could not institute, the more delicate, the more immeasurably superior to any performance of human hands, do all the divisions and parts of the vast work appear.

Nothing, we think, can be more fortunate than the induction by which Mr. Bell has thus unfolded the marvellous contrivances that are combined in the arrangement of the eye—having demonstrated with admirable patience and precision, that there are five different objects to be provided for by appropriate nerves:—1. vision; 2. common sensibility; 3. the voluntary direction of the eye-ball; 4. the condition of the eye in sleep, or at perfect rest; 5. the instinctive and rapid motions in winking, to protect the eye whilst it is exercised and watchful; and lastly, it has been shown, by some curious observations, in a manner quite unexpected, that there is a necessity for a connexion between the muscles of the eye, and the muscles of respiration generally, without which this delicate object would suffer derangement. It was only by such minute attention to the functions of this part that he could arrive at the rationale of the number of nerves (no less than six) going into the orbit.

Our author has certainly grappled here with the most difficult part of the whole system: And yet the advantage of his method might perhaps have been better illustrated by attending to the different operations of the tongue, which is the instrument of deglutition—the principal instrument of articulate language—the seat of an ex-

quisite sense of touch—and the organ of taste. This explains why there are three nerves distributed to it, each of which forms different connexions with other nerves; that nerve which is the organ of taste being connected with the salivary glands and muscles of mastication; that which connects the muscles of the tongue with those of the fauces in swallowing, passes down to the muscles of the pharynx; whilst that which is the organ of volition is connected with the nerves of the larynx, and the nerves of respiration generally,—to combine the actions of the tongue in articulate language with the act of breathing.

It has too commonly happened that those who have been ambitious to improve medical science have neglected this instructive study, for the sake of experimenting. The example of reserved and judicious appeal to experiment, in support of views derived from attention to structure, presented in these labours of Mr. Bell, is, in this point of view, particularly instructive. Whilst he never seems to have performed an experiment which could have been avoided, and has decidedly escaped all reasonable censure on the score of cruelty, not one of his experiments appears to have been idle or fruitless. The rash and unadvised destruction of animal life, in quest of whatever may chance to turn up, or of whatever is new and rare, can by no pretext be justified. The subject which now occupies us has been followed with every variety of investigation, and attempts have been made to snatch, as it were, a knowledge of the most hidden things of the Nervous System, by experiments without number; yet the results of injuries, most heedlessly inflicted on various portions of the cerebral mass cannot be said to have led to conclusions that we can at all rely upon, even respecting the parts actually involved in such injuries. In many instances the only effect has been the loss of power to direct the movements of the body, and a general diminution of sensorial power—from which no precise conclusion can be drawn. All that has been got at in this way, with all the diligence and all the disregard of life, by which the attempts have been characterised, is not to be compared with the valuable results obtained by those physiologists who, labouring more patiently, and having caught a steady view of some important fact, have first mutually considered which, of many paths, would most surely lead them to the point; and who have then, by careful reasoning, aided by knowledge industriously gathered from various sources, proceeded, by the light of a few decisive experiments, step by step, to what has been hailed, by all competent judges, as equally valuable and indisputable. Such physiologists proceed like the skilful miner, who, having first ascertained, from indications that cannot err, that there is a precious vein beneath the surface, commences his labour when it can be commenced with the most advantage.—Those of another description are like wild speculators, the Dousterswivels of science, who either proclaim a treasure when none exists, or lose their time in indiscriminate search; and, in their eagerness

for gold, assert what is not true, or waste their illdirected industry on hopeless and ungrateful soils. We are told by Celsus that, even before his time, and in the age of Alexander, Erasistratus indulged himself very freely in the examination of the bodies of criminals whilst they were yet alive, 'etiamnum spiritu remanente,' and saw the contractions of the heart, and beheld the lacteal vessels of the mesentery filled with chyle; but it was many hundred years later before the use of the lacteals, or of the action of the heart, were comprehended; and the knowledge of their uses was gained in a very different manner. The immortal Harvey, in relating his own progress, says, '*I began to think whether there could be* any motion of the blood, as in a circle; *which I afterwards found to be true.*'— And thus it has probably always been, and must always be, with great discoveries. In the midst of patient research, accident presents a single fact unthought of before, and the fact kindles a train of conjecture; a possibility is imagined; the faculties employed in the investigation and comparison of facts, are called into exercise; reasoning suggests experiment, and directs pursuit; careful observation governs and regulates the whole process, and a great truth is evolved.

It would be to forget half the value of the enlightened views of the structure and functions of the Nervous System which have occupied our attention, if we were not to allude to the great improvement that may be expected to arise from them to medical science. From understanding the anatomy and office of any part of the system, to clear ideas of the diseases of such structures of functions, the step is easy and direct; and when both are understood, it is not difficult to apply principles of treatment with increased effect. To the Surgeon there are many very obvious applications of the information given by Mr. Bell, concerning the properties of two great nerves of the face. Here the division of different nervous branches has been frequently performed for the relief of that distressing disorder, the Tic Douloureux; sometimes with complete success, but sometimes not only without benefit, but with consequences highly inconvenient; events which can now be explained. Whether the branches of the portio dura, or respiratory nerve of the face, may not in certain states of disease be affected with pain, is perhaps a question not quite decided; but it is easily understood, from the uses of this nerve, that if any attempt is made to relieve pain by dividing any part of it, there will be a loss of motion in some part of the muscles of the face, and consequent deformity; and if in this, or any other operation about the eye-lids, this nerve should be divided in that situation, consequences still more unfortunate would ensue; for it is the nerve on which the motions of the eyelids depend, and as they could not then be closed, the cornea of the undefended eye would become opaque, and the sight of the eye would be lost.

When a man has been deprived of all sensation and power of voluntary motion below the lower part of the neck, by an injury of the spine in that part, but continues to inspire and expire naturally,

can cough, blow his nose, &c., we learn from Mr. Bell's observations, that the continuance of his respiration does not depend on the continued power of the phrenic nerve alone, of which the origins are higher than the seat of the injury; and we comprehend, that if the motions of the thorax and abdomen depended wholly on the regular nerves, we should see *them* also suspended. But the phenomenon is sufficiently explained, when we remember that these alternate respiratory motions are a consequence of the unimpaired state of the respiratory nerves in a wider sense, of the phrenic for one certainly, but also of the superior and external respiratory nerves, of which the origins are as high as those of the phrenic. If the injury happens above the orign of the phrenic nerve, but not so high as that of the spinal accessory, breathing will still be carried on, though for a short time only; the action of the diaphragm is lost, and the patient breathes with much effort of the shoulders, between which the head is almost drawn at every inspiration; those muscles being now principally called into action which are supplied by the spinal accessory. In these, and other accidents affecting the spinal column, the surgeon is therefore now enabled to judge more correctly of the seat of the injury, often inaccurately referred to by the patients themselves; and he is enabled better to assign a reason for the continuance of life in deep and serious wounds of so important an organ as the brain; as well as to account for the strange circumstance which is witnessed in some monstrous births, in which respiration is performed, although there is no brain at all.

To the physician, the advantages of an exact acquaintance with the Nervous System are even greater. Instead of rejecting nervous theories, as some eminent practitioners have done, in the most unqualified terms, the physician may now find in this delicate system secure foundations for valuable practical improvements; may explain much that was before obscure, and much, that, though successful, was but empirical; may distinguish partial from general affections of the nerves with more certainty, and enlarge the powers and applications of medicine. Diseases, of which the phenomena were apparently most arbitrary and intractable, must now become more clearly understood and more easily managed. Distinctions also may be more readily made between external phenomena depending on slight and temporary paralysis, occasioned by partial affections of the muscles of the face, and those more serious cases originating in the brain: and, of course, between affections of the symmetrical and the superadded nerves. The symptoms of what are really nervous disorders, affecting different systems, may be more confidently referred to the causes affecting what may be called their anatomical origins, and better arranged; and in very many forms of disorder, the signs which indicate danger, or afford reasonable ground of hope, signs connected with the respiratory system, will be more justly appreciated. Even those sudden and alarming occurrences will be less mysterious, in which instantaneous injury, or overwhelming

pressure of the medulla oblongata, extinguishing the function of respiration at once, produces immediate death, those cases in which, as Dr. Bell observes, 'the change takes place with appalling suddenness; not a breath is drawn, nor a word uttered, nor a struggle to indicate pain, nor a feature discomposed.' And although this exact knowledge does not always confer immediate practical advantage, it seldom fails to lead to some ultimate benefit, and to the acquisition of some unforeseen resources against disease. Those who are engaged in the investigation of any science, can never see the full extent of the advantages which will reward their diligence, according to the sevenfold liberality with which intelligent industry is always repaid, that no inducement may be wanting to engage in it. The daily instances of respiration being affected in consequence of the presence of some offending matter in the stomach, so often, for instance, exemplified in asthma, are at once explained, when the close alliance between the stomach and respiratory nerves is clearly known; and the less distressing, but inconvenient affections of the same system, producing odd twitchings and catchings of the eyelids, or face, or shoulders, are no longer incomprehensible; and a nearer approach may be made towards understanding that singular disorder, called Angina Pectoris, which certainly does not always depend on a diseased state of the heart. Abundant pathological evidence is scattered through the pages of Mr. Bell's works, and bearing on all parts of the inquiry.

In one instance, the inconvenience of cutting a branch of the portio dura, going to the angle of the mouth, though not very great, was yet very marked; it was done by Mr. Bell himself, in taking out a tumour from before the ear of a coachman, and the man complained that he could no longer whistle to his horses. Numerous cases, indeed, of a similar kind, have now been amassed, and the Appendix to the Papers on the Nerves, consists entirely of such, chifly communicated to him by other practitioners, and completely proving all that is required.

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TO SUBSCRIBERS.

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The great delay in the publication of this number requires an explanation. On the 18th of September, the day on which the printing of the number was commenced, the Editor, in rescuing one of his friends from the flames, suffered extensive burns on both his hands. The accident was followed by various afflicting constitutional disorders, from which at this time, October 24, he is but beginning to recover. He was thus prevented from finishing several original articles for the number, and has been compelled to substitute selected matter; which he hopes, however, from its intrinsic excellence, will not be unacceptable to his readers.

The October number will positively be committed to the press in a few days, and issued with all possible expedition.

MEDICAL SOCIETY.

The semi-annual meeting of the *First District Medical Society of Ohio*, will be held in Cincinnati at the Medical College Edifice, *on the last Tuesday of November*, 1828, commencing at 10 o'clock in the morning.

JAMES M. MASON, M. D.
Recording Secretary.